5

FIREFIGHTER CASUALTIES

There has been much progress in reducing on-duty firefighter deaths and injuries over the 10 years 1985–1994 (down 35 percent). Since 1988, firefighter deaths have dropped from 136 to 104. Deaths in 1992 and 1993 reached all-time lows at 75 and 78, respectively. Injuries declined 2 percent and ranged from 95,400 (1994) to 103,300 (1991). These deaths and injuries include casualties from fires, training, and all other on-duty activities. This chapter addresses only casualties associated with fire incidents, with emphasis on information available from NFIRS data. NFIRS does not collect data on injuries from training or non-fire incidents.

Previous editions of *Fire in the United States* focused primarily on firefighter injuries. This edition examines both firefighter deaths and injuries in separate sections.

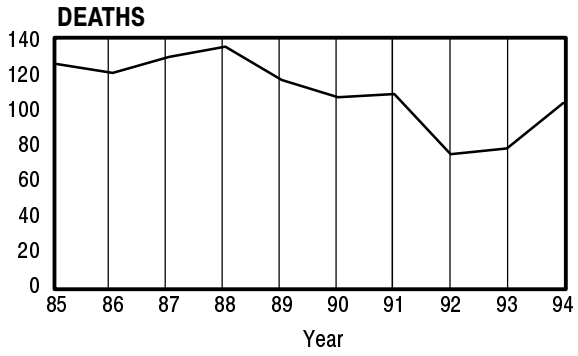
DEATHS

In 1994, 104 firefighters died while on duty.[1] This is a significant rise after two consecutive years that produced the lowest number of firefighter fatalities since the USFA began keeping records. The increase is attributable primarily to wildland fire fatalities, up from 8 deaths in 1993 to 38 deaths in 1994, including 14 firefighters killed in a single incident on Storm King Mountain in Colorado. Even with this exceptional incident, the total of 104 fatalities is still the third lowest number of fatalities recorded in the 18 years that these data have been collected and continues the long-term trend of reduced fatalities that began in 1979.

Figure 105 shows firefighter deaths increased 33 percent from 1993 to 1994 (26 additional deaths) The number of fatalities involving wildland firefighters increased by 30 deaths from the previous year. The fatalities by type and gender of firefighter are presented in Table 15.

Of the 38 deaths associated with wildland firefighting, 22 occurred on the fireground and 14 involved personnel en route to wildland fires. The other two deaths involved career individuals who

[1] A total of 107 firefighter fatalities were reported in 1994. Three of these deaths were attributed to incidents that occurred in prior years. Two firefighters died in 1994 of complications from prior injuries, one from an accident in 1979, and one from a heart attack in 1991. Another firefighter died of AIDS believed to have been contracted while performing emergency medical services in the 1980s. Since the exact date of exposure was not documented, his death has been attributed as a 1991 statistic, the year in which he was first diagnosed with HIV. Those deaths have been added to the statistics for the year in which the incident occurred, consistent with past USFA analyses. The data from two other incidents that occurred in 1994 are included in this analysis, although the firefighters actually died in 1995.



1985	126	1990	107
1986	121	1991	109
1987	130	1992	75
1988	136	1993	78
1989	117	1994	104

10-Year Trend = –35.3%

Sources: NFPA Annual Surveys and the United States Fire Administration

Figure 105. Trends in 1994 Firefighter Deaths

were deployed to positions primarily dedicated to wildland fire protection, although their deaths were from injuries sustained while performing other duties.

Table 15. 1994 Firefighter Deaths

Firefighter Type/Gender	Fatality
Firefighter	
Volunteer	38
Career	34
Wildland Firefighter	
Seasonal	20
Career	4
Contract Aircraft Crew	6
Industrial Emergency Response Team Members	1
Civilians Assigned to Military Reserve Units	1
Men	97
Women	7

Source: United States Fire Administration

The 36 deaths attributed to wildland fireground operations or response to wildland fires is considerably higher than in any previous year that has been analyzed. Fireground deaths at wildland incidents have varied considerably from year to year, but have averaged between 8 and 10 in the most recent years. Although the loss of 14 firefighters in the Storm King Mountain incident represents a significant portion of the total deaths for the year, the overall increase is significant even if this event were excluded from the total.

Activity and Type of Duty

In 1994, 84 percent of firefighter on-duty deaths were associated with an emergency incident (Figure 106). This number includes firefighters who died responding to an emergency, at the emergency scene, and returning from the emergency.

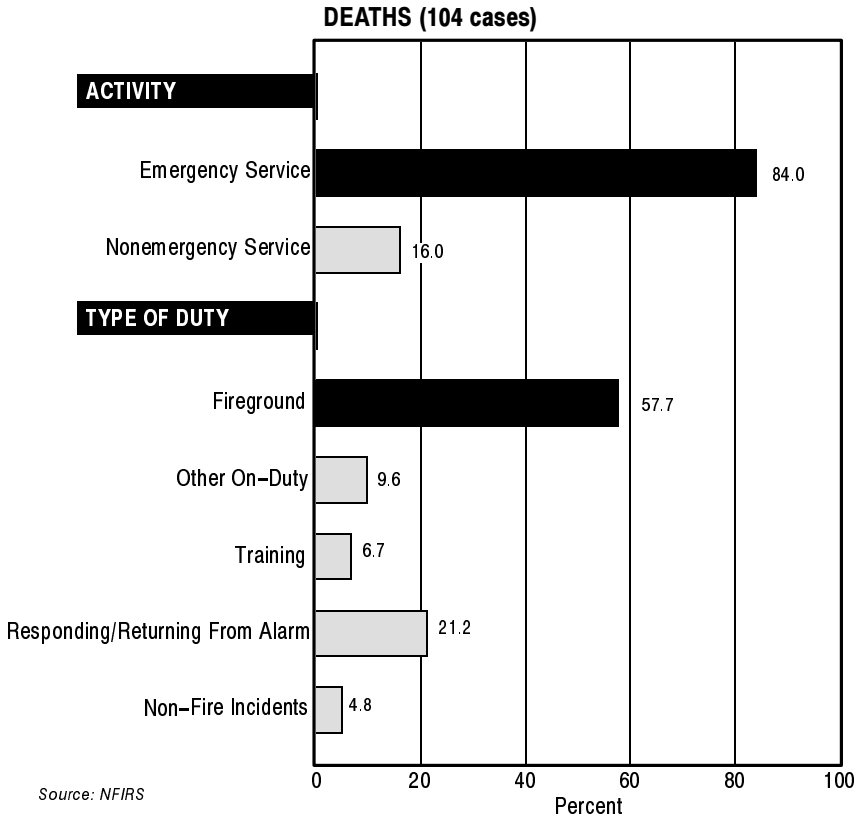


Figure 106. 1994 Firefighter Deaths by Activity and Type of Duty

The remaining 16 percent of firefighter fatalities included training and administrative activities and other functions not related to an emergency. Two on-duty firefighters died in their sleep of heart attacks, and one volunteer firefighter suffered a fatal heart attack doing clerical work at the firehouse.

Firefighter deaths by type of duty is also shown in Figure 106. As in previous years, the largest number of deaths resulted from fireground operations, 58 percent. Of the 60 fireground deaths, 29 were attributed to smoke inhalation,[2] 8 to burn injuries, and 3 to trauma (including two pilots who were killed when their plane crashed while dropping retardant on a wildfire). Nineteen heart attack deaths were attributed to fireground operations, including one that occurred after returning from a fire. One firefighter was electrocuted and one died of an embolism after being injured in a fall at a fire.

As in 1993, the second leading category of firefighter deaths after fireground operations was responding to and from emergency incidents, which accounted for 22 deaths in 1994. Two firefighters and a patient were killed while en route to the hospital when their ambulance was struck head-on by a tractor-trailer truck. Eight fatalities occurred in fire apparatus crashes, with rollovers being

[2] The 14 firefighters who died at Storm King Mountain were listed as smoke inhalation deaths on their death certificates.

the leading type of fatal accident. Six deaths resulted from aircraft that crashed during wildland firefighting operations. Five firefighters suffered fatal heart attacks while en route or returning from alarms. One volunteer firefighter was killed in a crash of a personal vehicle.

Five deaths were related to activities at the scene of emergency medical (non-fire) incidents. Two were struck by vehicles—one firefighter was killed while on an emergency medical call and the other, a fire-police officer, died while directing traffic at the fire scene. Three firefighters died of heart attacks—one after extricating a patient from an automobile accident, another after returning from an EMS incident in very hot weather, and a third after carrying a patient to an ambulance.

Seven deaths occurred during training, although none involved live fire training. Five of the training deaths were from heart attacks and one of a cerebral aneurysm. A fire management officer was killed when a 106-mm recoilless rifle exploded during avalanche control training. This training was part of his collateral duties.

Ten deaths occurred during other nonemergency duty activities.

Cause and Nature of Fatal Injury or Illness

The term *cause* refers to the action, lack of action, or circumstances that directly result in the fatal injury, while the term *nature* refers to the medical nature of the fatal injury or illness, or what is often referred to as the cause of death. The fatal injury usually is the result of a chain of events, the first of which is recorded as the cause. For example, if a firefighter is struck by a collapsing wall, becomes trapped in the debris, runs out of air before being rescued, and died of asphyxiation, the cause of the fatal injury is recorded as "struck by collapsing wall" and the nature of the fatal injury is "asphyxiation." Likewise, if a wildland firefighter is overrun by a fire and dies of burns, the cause of the death would be listed as "caught/trapped," and the nature if death would be "burns." This follows the convention used in NFIRS casualty reports, which are based on NFPA fire reporting standards.

Figure 107 shows the distribution of deaths by cause of fatal injury or illness. As in most previous years, the leading cause is stress or overexertion—36 percent in 1994. The act of firefighting has been shown to be one of the most physically demanding activities that the human body performs. Of the 37 stress-related fatalities in 1994, 36 firefighters died of heart attacks and 1 firefighter died of an aneurysm.

The second leading cause of firefighter fatalities in 1994 was "caught or trapped," accounting for 36 firefighter fatalities (35 percent). Seventeen firefighters were overrun by moving brush or wildland fires. Nine firefighters were trapped by rapidly changing fire conditions inside burning structures, and seven apparently became disoriented and died in building fires. Two firefighters died as a result of structural collapses. A fire chief who was directing operations outside of a burning garage died from burns after it exploded.

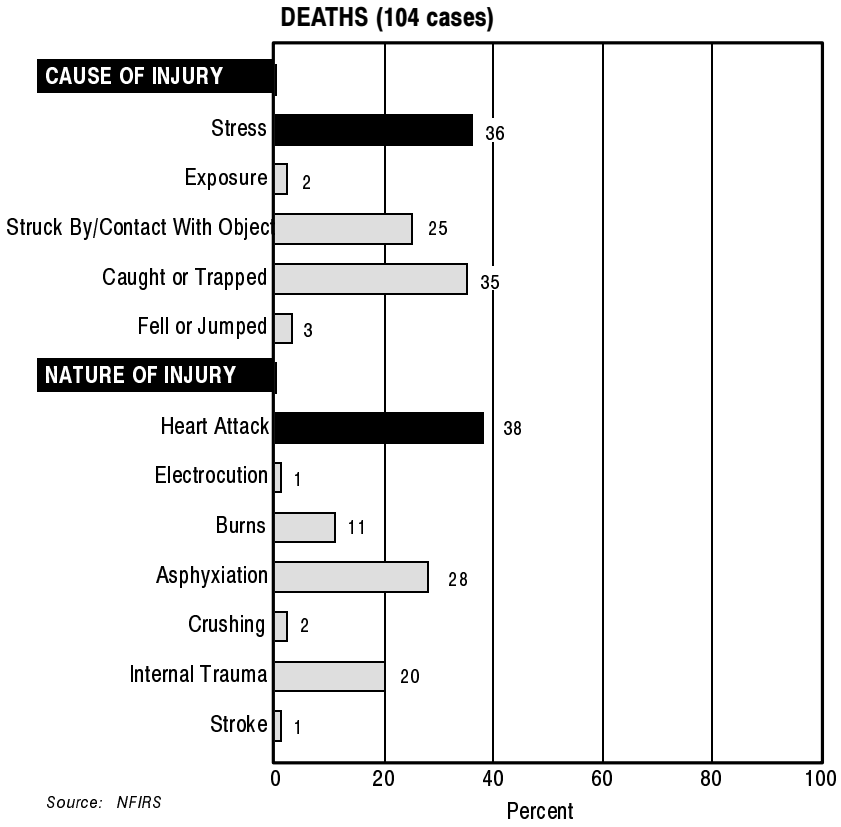


Figure 107. 1994 Firefighter Deaths by Cause and Nature of Injury

The third leading cause of firefighter fatalities was "struck by" or coming in "contact with an object." Of the 26 firefighters (25 percent) killed, 11 were in vehicle accidents, 8 were in aircraft accidents, 2 were struck by vehicles while at the scene of an emergency, 1 was struck by a falling tree, 1 was struck by a helicopter rotor blade, 1 was hit by shrapnel when a 106-mm recoilless rifle misfired and exploded, 1 was struck by falling debris at a fire, and 1 was electrocuted when he came in contact with an electric power line while carrying a chainsaw down an aerial ladder from the roof of a fire building.

Three firefighters (3 percent) died as a result of falls. One died when he fell through a hole in the floor while checking a room for fire extension; one firefighter, who suffered a broken ankle in a fall down stairs at a fire, died of an embolism; and one died when he fell from the roof of his fire station.

Exposure to smoke or toxic gases was listed as the causal factor of two deaths (2 percent). A chief officer suffered a fatal heart attack after breathing toxic gases while performing overhaul at a house fire. He was not wearing protective gear or SCBA. Another firefighter suffered a fatal heart attack after being overcome by heat and toxic gases while standing by at a controlled burn.

Figure 107 also shows the distribution of the 104 deaths by the medical nature of the fatal injury or illness. Thirty-nine firefighters died of heart attacks in 1994—36 by stress, 1 by an embolism, and 2 by inhalation of toxic gases on the fireground. At least 13 of the firefighters had known high-risk

factors for heart attacks, including prior heart conditions, high blood pressure, or obesity, including two who continued to perform firefighting activities after bypass surgery. Autopsy results indicated some coronary artery disease present in most of these cases where medical records were available.[3] Obesity and poor physical fitness were noted as factors in the deaths of several of the heart attack victims, including a 26-year-old, 5½-foot, 275-pound firefighter who died of a heart attack during a training exercise. At least one firefighter had a genetic heart defect that would not have been discovered during a routine physical.

Asphyxiation was the second leading nature of firefighter deaths. A total of 29 firefighter deaths (28 percent) resulted from carbon monoxide poisoning or smoke inhalation: 15 from wildland fires[4] and 14 at structure fires. This includes seven firefighters who were using SCBA, but whose air supply had been depleted.

Internal trauma was responsible for 21 deaths (20 percent). This includes 19 who were involved in vehicle or aircraft accidents.

Burn injuries claimed the lives of 11 firefighters (11 percent). Five died after being caught in flashovers or backdrafts, three died after aircraft accidents, two died after being overrun by wildfires, and one died after being caught in an explosion with no protective clothing.

Two firefighter deaths (2 percent) were attributed to crushing injuries—one from falling debris from a roof collapse, and the second by a falling tree. One firefighter was electrocuted (1 percent). Another firefighter died of a stroke (1 percent).

Ages of Firefighters

Table 16 shows the distribution of firefighter deaths by age and nature and cause of death. Younger firefighters were more likely to have died after becoming caught or trapped during firefighting operations. Stress played an increased role in firefighter deaths as ages increased—all six firefighters who were over 60 years old died of heart attacks. Asphyxiation was the primary medical nature of death among younger firefighters, and heart attacks were much more prevalent among older firefighters.

Fireground Deaths

Fireground deaths in 1994 accounted for 58 percent of total deaths, an increase of 77 percent over 1993. Figure 108 shows the fireground deaths by fixed property use, including the 14 deaths that occurred on Storm King Mountain.[5]

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[3] Autopsy results and medical records were not available for all heart attack victims.

[4] The autopsy results of the 14 Storm King Mountain fatalities established that their deaths were caused primarily by asphyxiation, secondarily by burns.

[5] Even if the 14 Storm King Mountain fatalities were removed from the statistics, the increase would still be a significant 35 percent.

Table 16. Age of Firefighter at Time of Death by Nature and Cause in 1994

	Age										
	Under 21	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	51 to 55	56 to 60	Over 60	Total
Cause											
Stress	0	0	1	3	5	4	6	6	6	6	37
Exposure	0	0	0	0	0	0	1	1	0	0	2
Struck/Contact With Object	3	2	5	3	2	3	1	4	3	0	26
Caught/Trapped	0	8	11	5	4	5	3	0	0	0	36
Fell or Jumped	0	0	0	1	0	1	0	1	0	0	3
Nature											
Heart Attack	0	0	1	3	5	3	7	8	6	6	39
Electrocution	0	0	0	1	0	0	0	0	0	0	1
Burns	1	3	0	3	2	0	2	0	0	0	11
Asphyxiation	0	5	11	3	3	6	1	0	0	0	29
Crushing	0	0	1	0	0	0	0	0	1	0	2
Internal Trauma	2	2	4	2	1	3	1	4	2	0	21
Stroke	0	0	0	0	0	1	0	0	0	0	1

Source: NFIRS

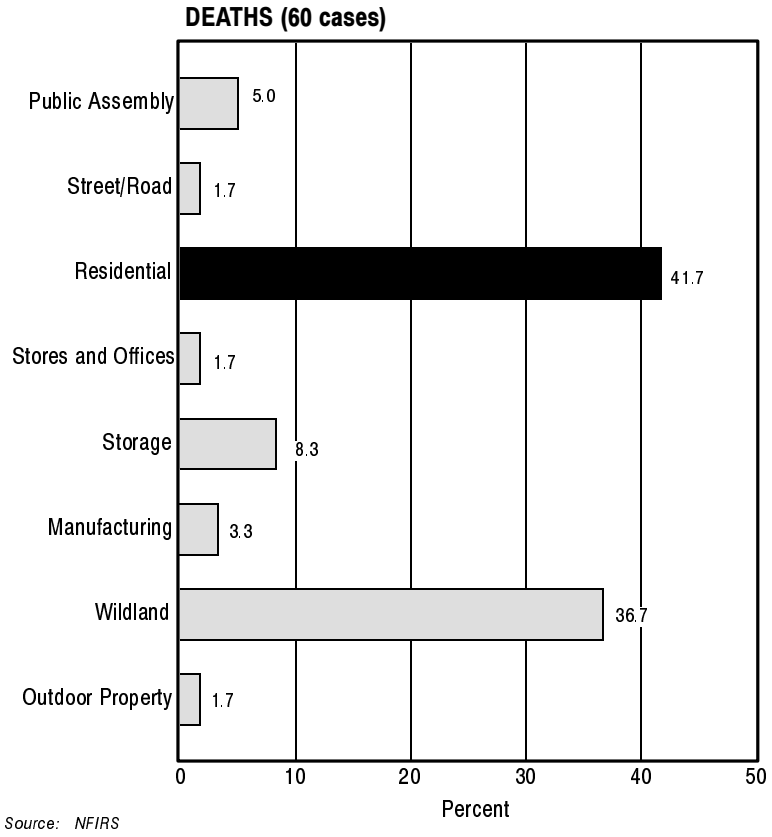


Figure 108. 1994 Firefighter Deaths on Fireground by Fixed Property Use

Residential occupancies accounted for the highest number of fireground fatalities in 1994 with 25 fatalities (42 percent). This is consistent with all prior years. It is not that residential fires are more dangerous, but rather that they are more common. (Residential fires accounted for 72 percent of all structure fires in 1994, but only 42 percent of firefighter fatalities.)

Twenty-two firefighters died while engaged in brush or wildland firefighting in 1994, up from 8 in 1993—an increase of 175 percent. Five firefighters died in storage occupancies, which include warehouses and other types of storage facilities. Three firefighters died in public assembly occupancies—all three in church fires. One died in a commercial use building fire, one died of a heart attack while standing by at an open field fire, and one died of a heart attack after returning to the station from an auto fire.

Figure 109 illustrates the activity the firefighters were engaged in at the time they sustained the injury or illness that caused their death. The activity of cutting fire lines to contain grass, brush, and forest fires accounted for 19 deaths, which is 32 percent of fireground fatalities and reflects the high number of wildland fatalities in 1994.

Search-and-rescue operations in burning structures were in process when 14 deaths (23 percent) occurred. This activity, the second highest category overall, is the highest category for structure fires. Analysis of these deaths reveals that nine died of asphyxiation, four died of burns, and

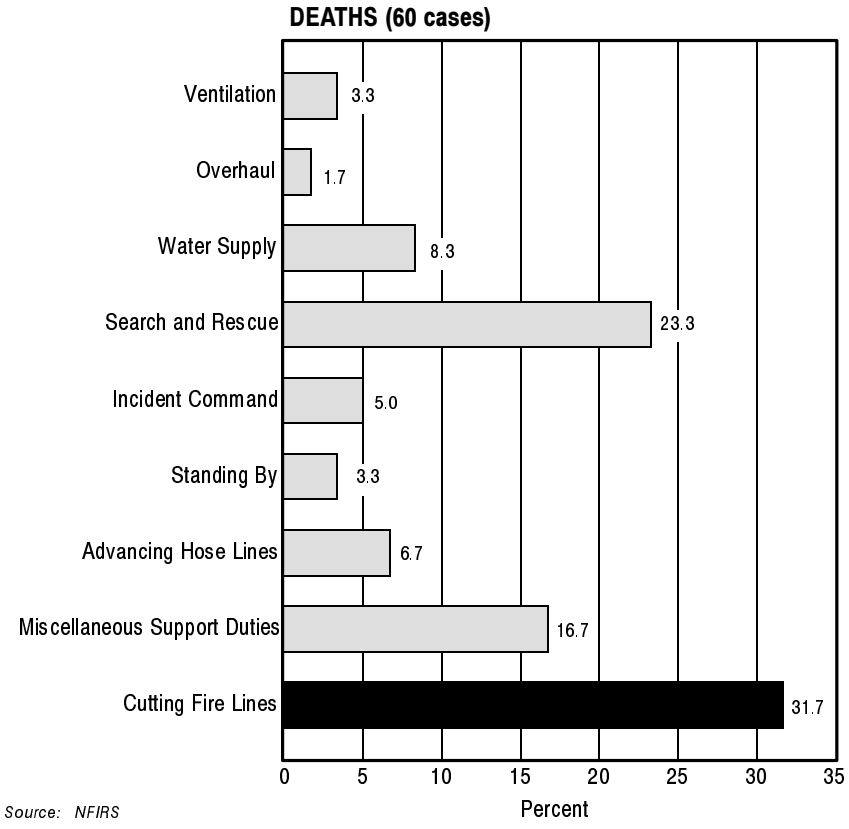


Figure 109. 1994 Firefighter Deaths on Fireground by Type of Activity

one died of a heart attack. At least 12 of these deaths may have involved firefighters who were conducting search operations on or above the fire floor while they or other companies were also ventilating the structure, resulting in rapidly changing fire conditions. This indicates the need for close communication and coordination between ventilation, search, and attack operations, and demonstrates the dangers of conducting search-and-rescue operations without a protective hose line, when the fire location is unknown, or when the fire has not yet been confined.

Support and other duties on the fireground accounted for 10 deaths (17 percent) of the 1994 fireground fatalities. Support duties include utility control, raising ladders, setting up equipment, or engaging in unspecified activities. These deaths include two pilots who were dropping slurry on a wildfire when their plane crashed and an industrial firefighter who died when he ran out of air at a fire in a building at a mine. Several firefighters included in this category suffered fatal heart attacks after arriving on the fireground but had not been assigned to specific activity.

Five heart attack deaths (8 percent) occurred during water supply activities. Three of these individuals were operating fire pumps and two were pulling supply lines.

The remaining 12 fireground deaths (20 percent) involved firefighters performing various other firefighting activities. Four firefighters died while advancing hose lines (7 percent); two officers suffered heart attacks and one officer was burned while they were commanding incidents (5 percent); and two firefighters were performing ventilation (3 percent)—one fell through the roof and the other was electrocuted descending a ladder. Two firefighters (3 percent) died of heart attacks while standing by at controlled burns, and one chief officer (2 percent) died during overhaul when he was exposed to toxic gases and suffered a heart attack.

Of the fireground deaths where firefighters were caught or trapped in burning buildings, at least four were found wearing personal alert safety system (PASS) devices that were in the off position. One firefighter was wearing a PASS device that activated when he became trapped, but rescuers were unable to reach him before he ran out of air. Another firefighter's PASS device was in the armed mode when he was found, but it was not reported if it was sounding. The status of PASS devices was not reported from any of the other fireground fatalities.

Time of Alarm

The distribution of 1994 fireground deaths according to the time of day when the incidents were reported is shown in Figure 110. The highest number of fireground deaths occurred for alarms that were received between 3 p.m. and 5 p.m.[6] The times of alarms where firefighters died were evenly distributed, with higher rates at 1–3 p.m. and 7–9 p.m.

[6] The high total is driven by the 14 firefighters killed on Storm King Mountain; the blowup occurred just before 5 p.m., but the fire had been burning for several days.

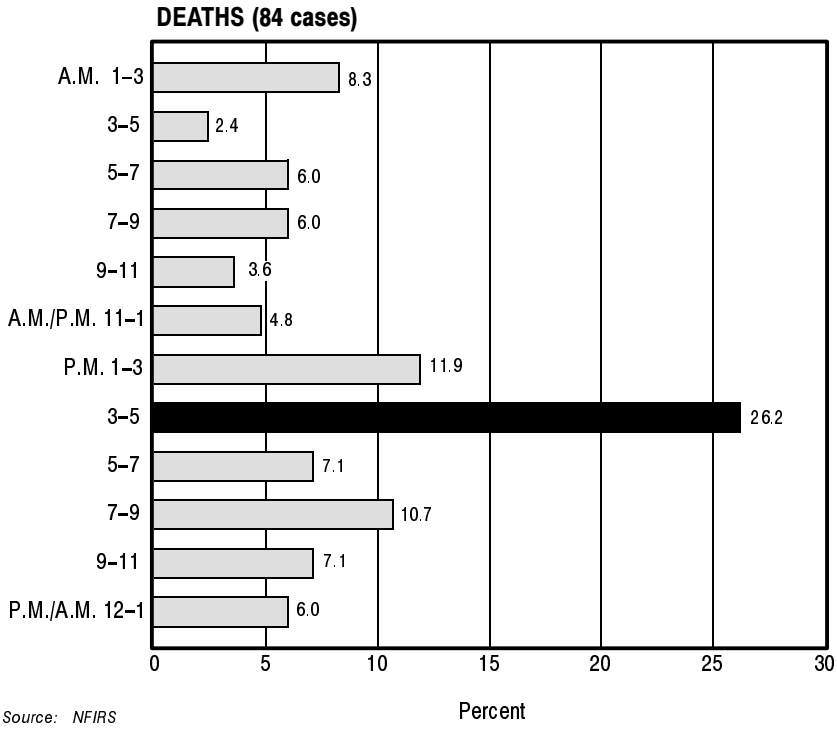


Figure 110. 1994 Firefighter Deaths by Time of Alarm

Month of the Year

Figure 111 illustrates firefighter fatalities by month of the year. Firefighter fatalities peaked in July, the month of the Storm King Mountain fire. Other high months were recorded in January and August. May had the lowest number of deaths.

INJURIES

Fire-related injuries constitute about 55 percent of all firefighter injuries, and numbered about 53,000 in 1994.[7] And in 1994 more than twice as many firefighters were injured as civilians. Figure 112 shows the 13 percent downward trend in the fireground portion of these injuries.

Injuries by Property Type

The majority of firefighter injuries (58 percent) reported to NFIRS are associated with residential fires, largely because that is the largest single subcategory of structural fires (Figure 113). Residential fires have double the number of firefighter injuries as do non-residential structures (25 percent). The proportions have been quite consistent over the 10-year period 1985–1994. Outside, vehicle, and other fires combined are 17 percent of firefighter injuries.

[7] NFPA reports fireground injuries as 52,900. To this should be added a portion of the injuries categorized as responding to or from an incident (which includes but is not limited to fires).

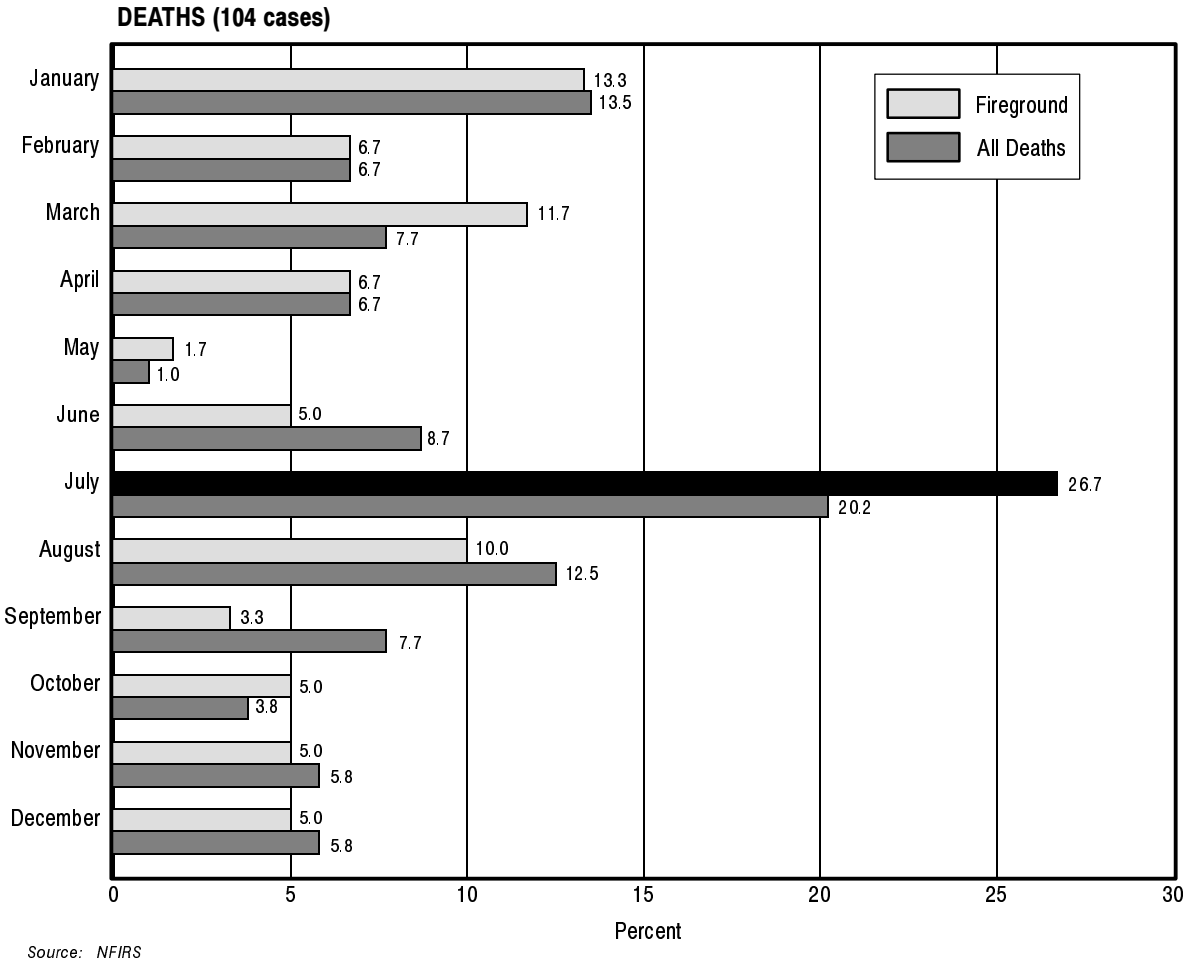
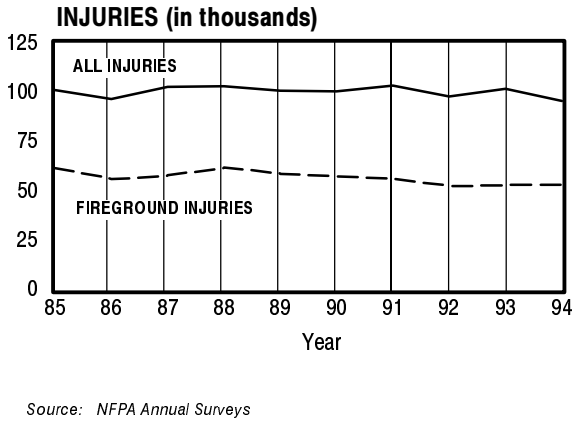


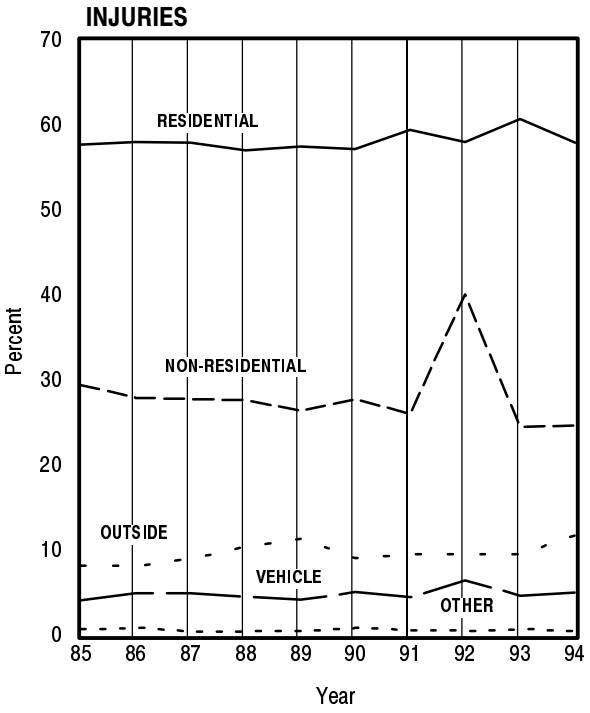
Figure 111. 1994 Firefighter Deaths by Month of Year



	All Injuries	Fireground
1985	100.9	61.3
1986	96.5	56.0
1987	102.6	57.8
1988	102.9	61.8
1989	100.7	58.3
1990	100.3	57.1
1991	103.3	55.8
1992	97.7	52.3
1993	101.5	52.9
1994	95.4	52.9

10-Year All Injuries Trend = –2.0%
10-Year Fireground Injuries Trend = –13.0%

Figure 112. Trends in 1994 Firefighter Injuries



	Residential	Non-Residential	Vehicle	Outside	Other
1985	57.7%	29.4%	4.1%	8.2%	0.7%
1986	58.0	27.9	4.9	8.2	0.9
1987	57.9	27.7	4.9	9.0	0.4
1988	57.0	27.6	4.5	10.4	0.5
1989	57.5	26.4	4.2	11.3	0.5
1990	57.2	27.7	5.1	9.1	0.9
1991	59.4	26.0	4.5	9.5	0.6
1992	58.0	40.1	6.4	9.5	0.5
1993	60.7	24.5	4.6	9.5	0.7
1994	57.9	24.7	5.1	11.8	0.4

Source: NFIRS

Figure 113. Trends in Firefighter Injuries by General Property Type

Figure 114 gives a more detailed look at the relative proportion of firefighter injuries by property type. Half of all firefighter injuries occur in structures at one- and two-family dwelling fires. Apartments account for another 19 percent.

The proportions of injuries by property type were consistent over 1985–1994. Figures 115 and 116 show these proportions for residential and non-residential properties.

Injuries per Fire

Firefighter injuries per fire have been gradually trending downward.[8] The injury rates for structural fires are over ten times those for outside, vehicle, and other fires (Figure 117).

Figure 118 shows that the firefighter injuries per fire for apartments and one- and two-family homes fires have been remarkably constant over the 10-year period. The injury rate for hotel/motel fires and other residential is down sharply, but both of these categories fluctuate considerably from year to year because of small sample sizes.

Figure 119 shows the firefighter injury rates per 1,000 fires for structural occupancies. Several types of non-residential properties, especially storage, manufacturing, vacant/under construction,

[8] The 1983–1994 NFPA *Fire Command* and NFPA *Journal* articles on firefighter injuries also show a downward trend in injuries per fire, from 9.4 injuries per 1,000 fires in 1983 to 7.3 in 1994. These rates are half the NFIRS injury rate for all fires. It is not clear why there is such a large difference; it may be a definitional problem.

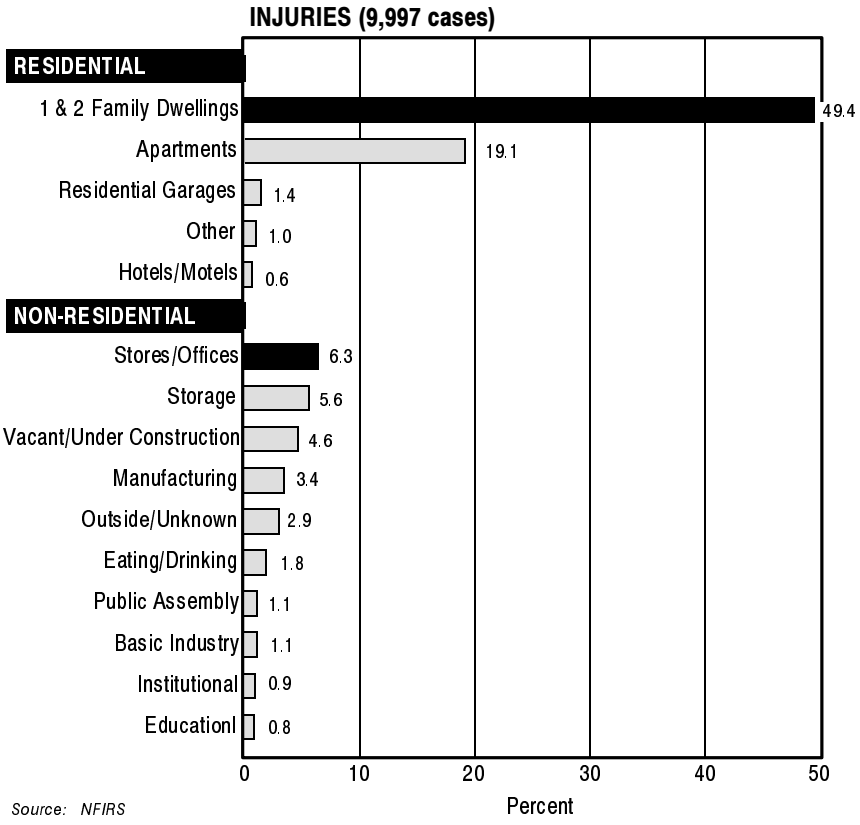
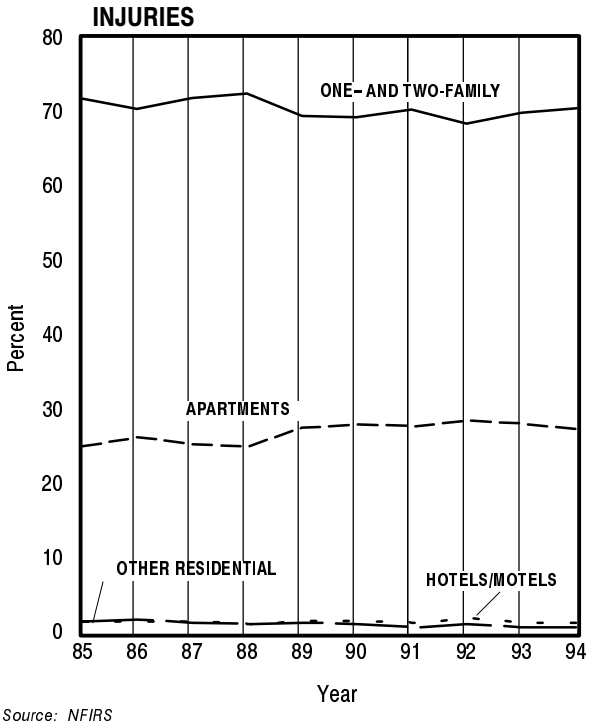
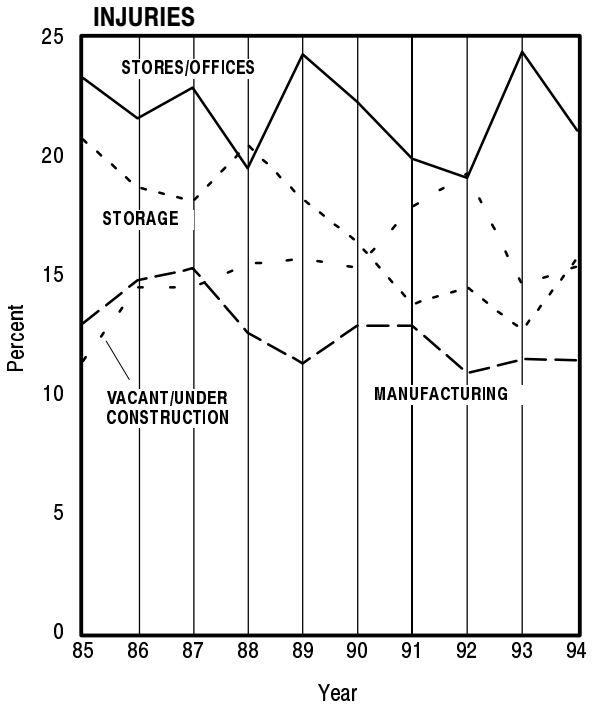


Figure 114. 1994 Firefighter Injuries by Property Type (Structure Fires Only)



	One- and Two-Family	Apartments	Hotels/Motels	Other Residential
1985	71.8%	25.1%	1.5%	1.5%
1986	70.4	26.3	1.8	1.5
1987	71.9	25.3	1.3	1.5
1988	72.5	25.0	1.2	1.2
1989	69.5	27.6	1.3	1.6
1990	69.3	28.0	1.2	1.5
1991	70.3	27.7	0.7	1.3
1992	68.4	28.5	1.2	1.9
1993	69.9	28.1	0.7	1.3
1994	70.5	27.3	0.8	1.4

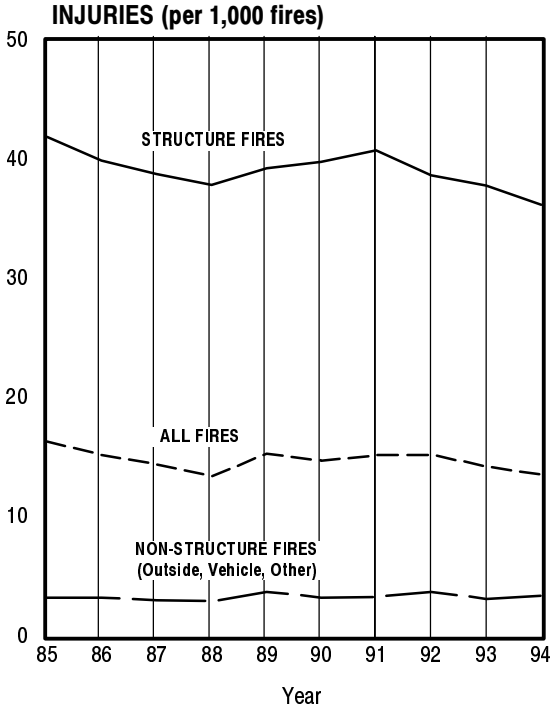
Figure 115. Trends in Firefighter Injuries in Residential Structure Fires



Note: Data for all 11 non-residential structure types are provided in Appendix B, Table B–6.

Sources: NFPA Annual Surveys and NFIRS

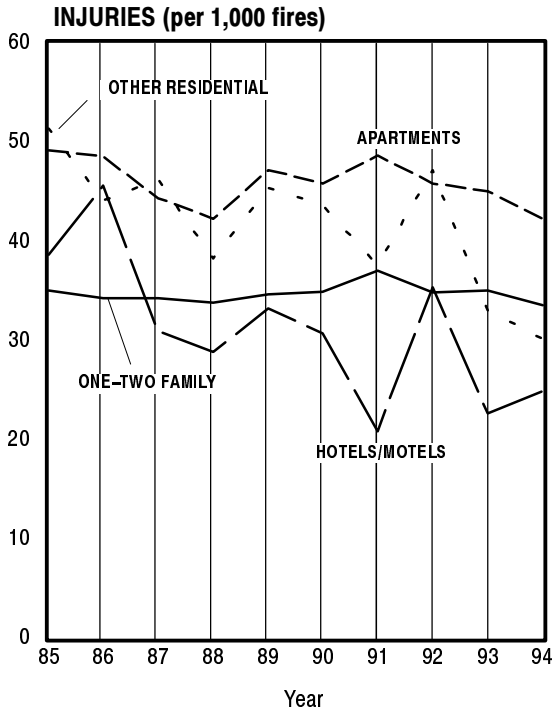
Figure 116. Leading Trends in Firefighter Injuries by Type of Non-Residential Structure Fires



	Structure Fires	All Fires	Non-Structure Fires
1985	41.9	16.3	3.2
1986	39.9	15.2	3.2
1987	38.8	14.4	3.0
1988	37.9	13.4	2.9
1989	39.3	15.3	3.7
1990	39.8	14.7	3.2
1991	40.8	15.2	3.3
1992	38.7	15.2	3.7
1993	37.8	14.2	3.1
1994	36.2	13.5	3.4

Source: NFIRS

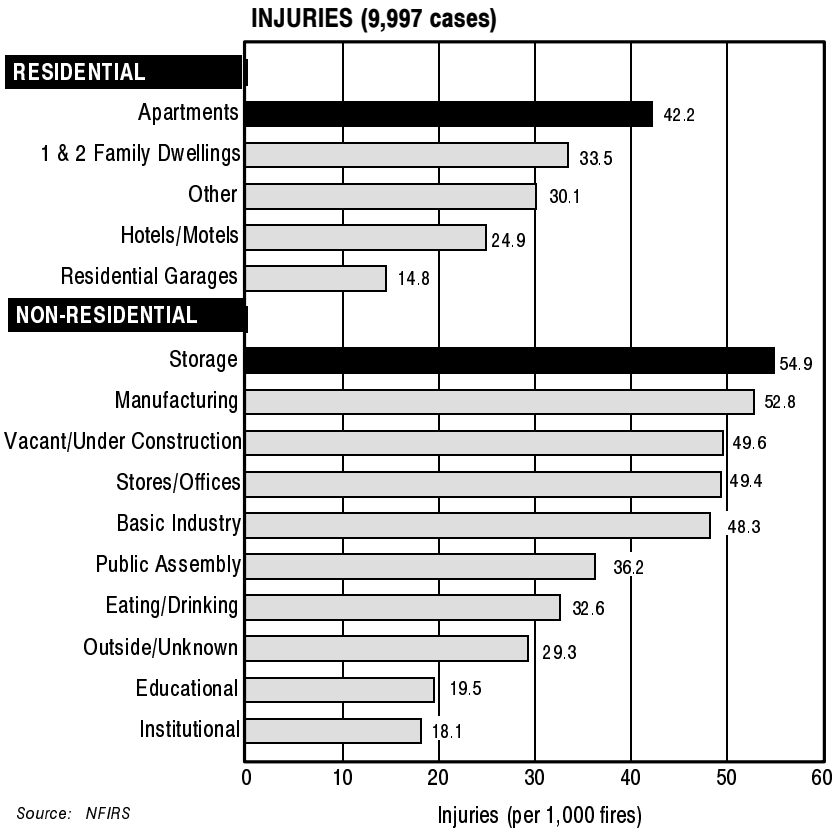
Figure 117. Trends in Severity of Firefighter Injuries by Type of Fire



	One–Two Family	Apartments	Hotels/Motels	Other Residential
1985	35.0	49.1	38.6	51.3
1986	34.2	48.5	45.6	44.1
1987	34.2	44.3	30.9	46.2
1988	33.8	42.2	28.8	38.2
1989	34.6	47.1	33.2	45.3
1990	34.9	45.8	30.7	43.6
1991	37.0	48.6	20.8	37.6
1992	34.8	45.8	35.3	47.1
1993	35.0	45.0	22.6	33.0
1994	33.5	42.2	24.9	30.1

Source: NFIRS

Figure 118. Trends in Severity of Firefighter Injuries in Residential Structure Fires

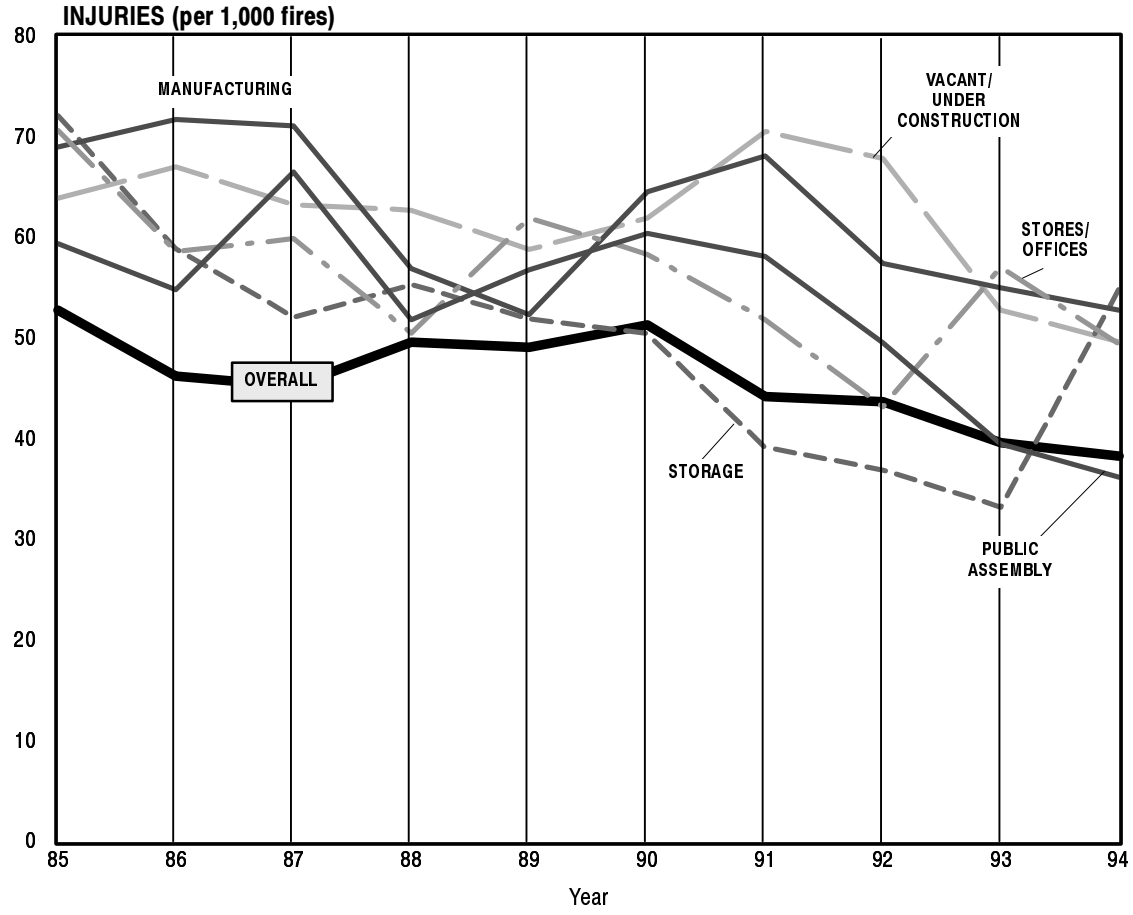


Source: NFIRS

Figure 119. Severity of 1994 Firefighter Injuries by Property Type (Structure Fires Only)

stores/offices, and basic industry pose the greatest risk. Residential properties pose less risk per fire than these non-residential properties.

Vacant properties have long been a firefighting concern (Figure 120). In the mid 1970s, the most dangerous fires were those in vacant properties and properties under construction. The layout of these structures is often unfamiliar and continually changing from week to week. Fire defenses built into such structures are often not working or only working partially. Also, there are many pitfalls where a misstep can cause serious injury. Many of these fires are started when no one is around and the fire gets considerable headway before the fire department is called. This combination makes them the third-most hazardous non-residential fire in 1994, behind storage (which leaped to first place) and manufacturing. When fighting fires in vacant properties, there is less of an inclination to risk firefighters' lives.



Note: Data on all non-residential fires provided in Appendix B, Table B–6.

Source: NFPA Annual Surveys and NFIRS

Figure 120. Trends in Severity of Firefighter Injuries in Non-Residential Structure Fires

For non-residential properties in general, the injury rate per fire fluctuates widely from year to year, but the four highest risk properties (storage, manufacturing, vacant/construction, and stores) are all trending downward—a promising pattern for firefighter fireground safety.

Characteristics of Injuries

AGE. Figure 121 shows the profile of firefighter injuries by age for all property types. One-third of all injuries occur to firefighters aged 30–39. The types of injuries incurred by firefighters vary with age. Typically, the leading cause of injury among younger firefighters relates to smoke inhalation and for older firefighter it is strains and sprains. These results relate to physical fitness variations with age, to the effect of age on assignments, and perhaps to the bravado of younger firefighters.

TIME OF DAY. More firefighter injuries occur after noon than before. However, there is no sharp peak. The times that are most hazardous to civilians (evening meal times for injuries) are not the same as the times firefighters get injured (Figure 122).

MONTH OF YEAR. Firefighter injuries are somewhat higher in the winter (December–March) when residential fires peak and again in June–August when outside fires are a factor (Figure 123).

PART OF BODY INJURED. The most common firefighter injuries in 1994 were to the torso, followed closely by arm/hand and leg/foot. All areas of the body are vulnerable, including internal injuries from smoke inhalation. The firefighter must protect his or her entire body with a complete protective outfit and be in good physical condition (Figure 124).

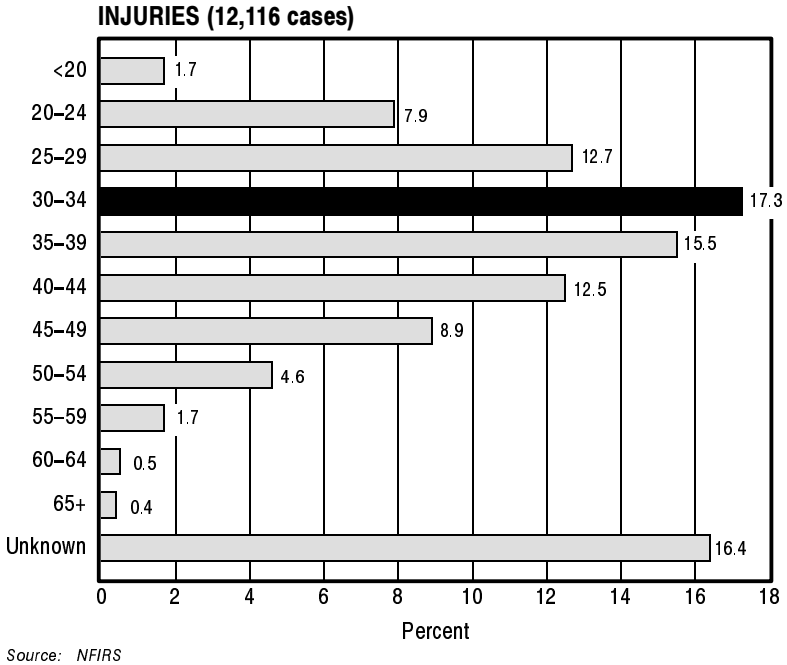


Figure 121. 1994 Firefighter Injuries by Age

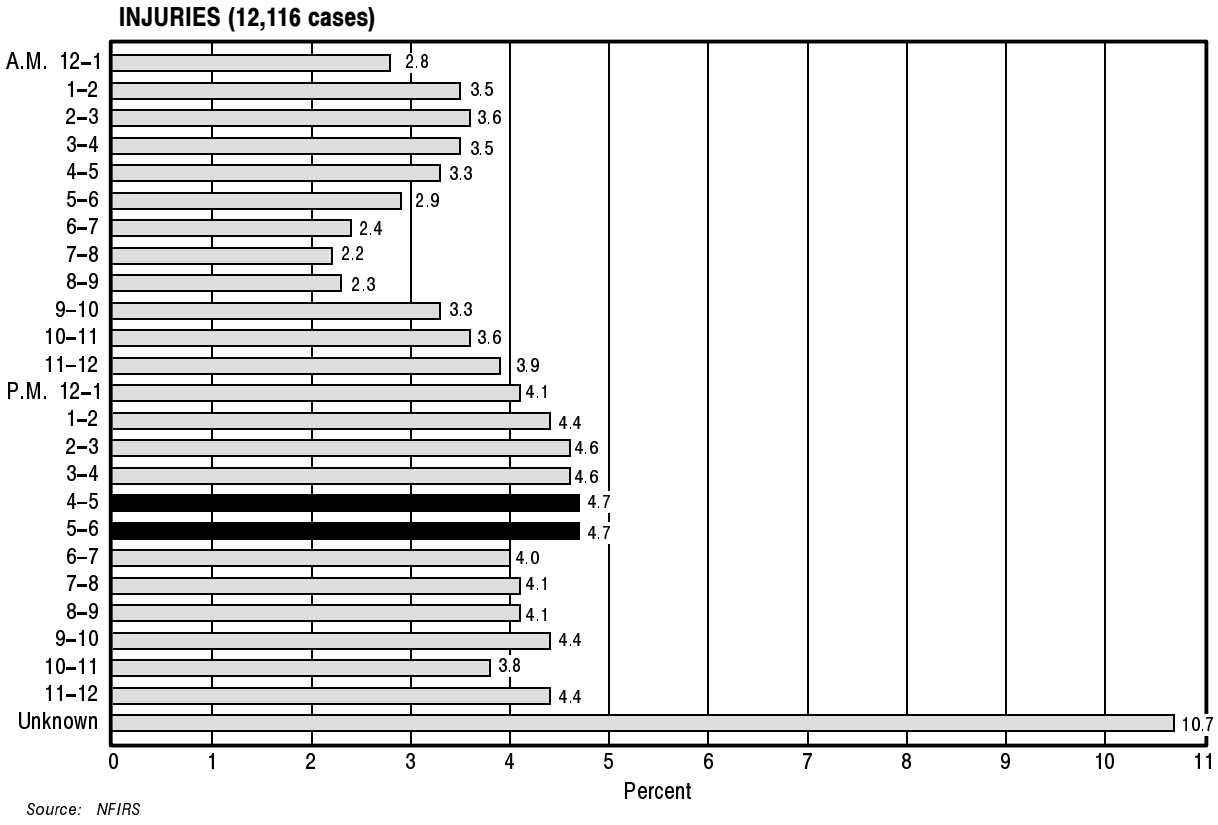


Figure 122. 1994 Firefighter Injuries by Time of Day

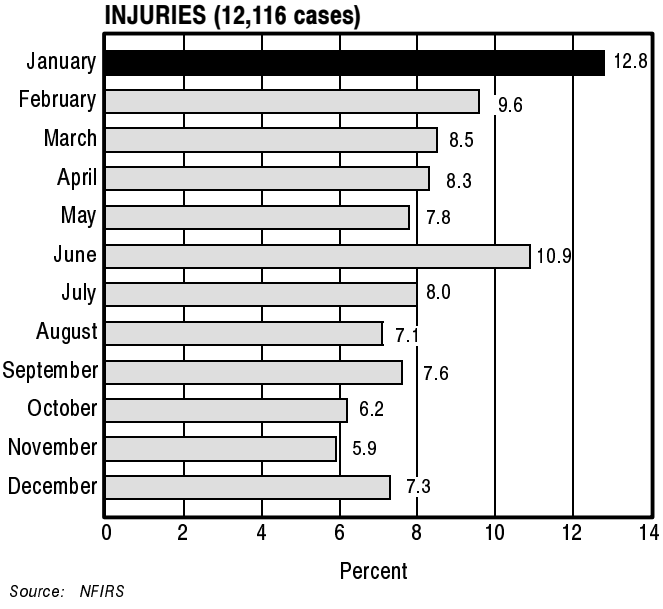


Figure 123. 1994 Firefighter Injuries by Month of Year

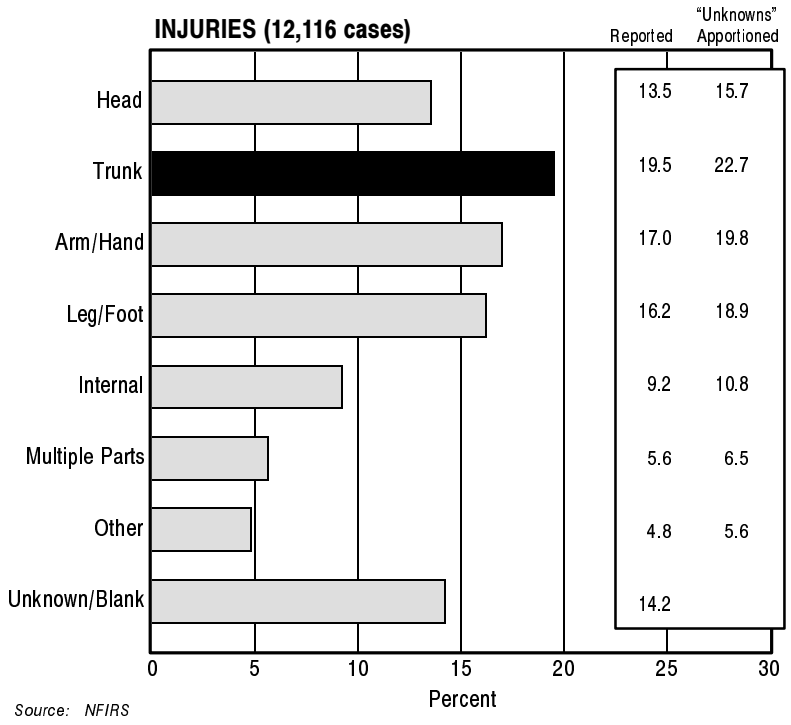


Figure 124. 1994 Firefighter Injuries by Part of Body Injured

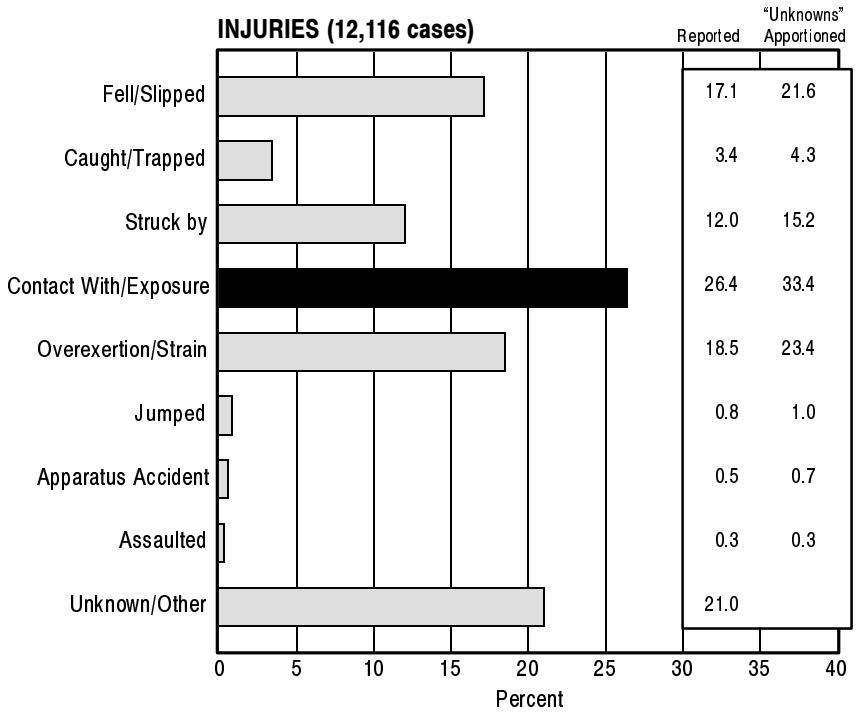
CAUSE OF INJURY. By far the largest category of firefighter injuries associated with fires was reported to be contact with or exposure to the flames or to smoke (33 percent of injuries, adjusted) (Figure 125). The second highest category was overexertion and strains (23 percent), followed closely by fell or slipped (22 percent). No cause was reported for 21 percent of the injuries.

WHERE INJURIES OCCUR. According to NFIRS, 91 percent of the firefighter injuries associated with reported fires occur on the scene above ground (Figure 126). This percentage is nearly equally divided between injuries occurring inside and outside the structure. Significantly smaller percentages are reported as occurring en route or below ground level. (As a reminder, there also are many firefighter injuries that are not associated with fires and that are not included here.) One-quarter of injuries did not have a reported location.

The striking point here is that many firefighter injuries (47 percent) occur in areas outside the fire building, where the firefighter might feel relatively safe. There often are more firefighters operating outside the fire building and exposed to injury than there are inside. Outside fires include vehicle fires, which contribute to this high incidence of injuries.

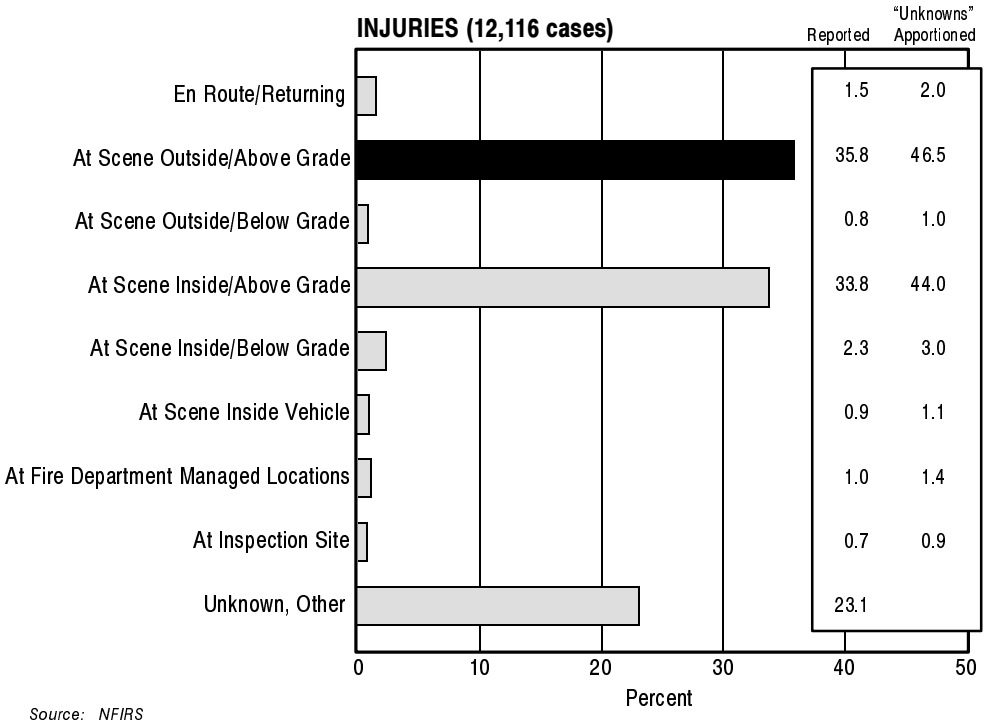
TYPE OF ACTIVITY WHEN INJURED. More than half of firefighter injuries occurred while extinguishing the fire; suppression support accounted for 23 percent (Figure 127).

TYPE OF MEDICAL CARE. Over half of the reported fire injuries associated with fires were treated at hospitals. Another 43 percent were treated but not transported. A small percentage (less than 5 percent) of firefighters were treated elsewhere (Figure 128).



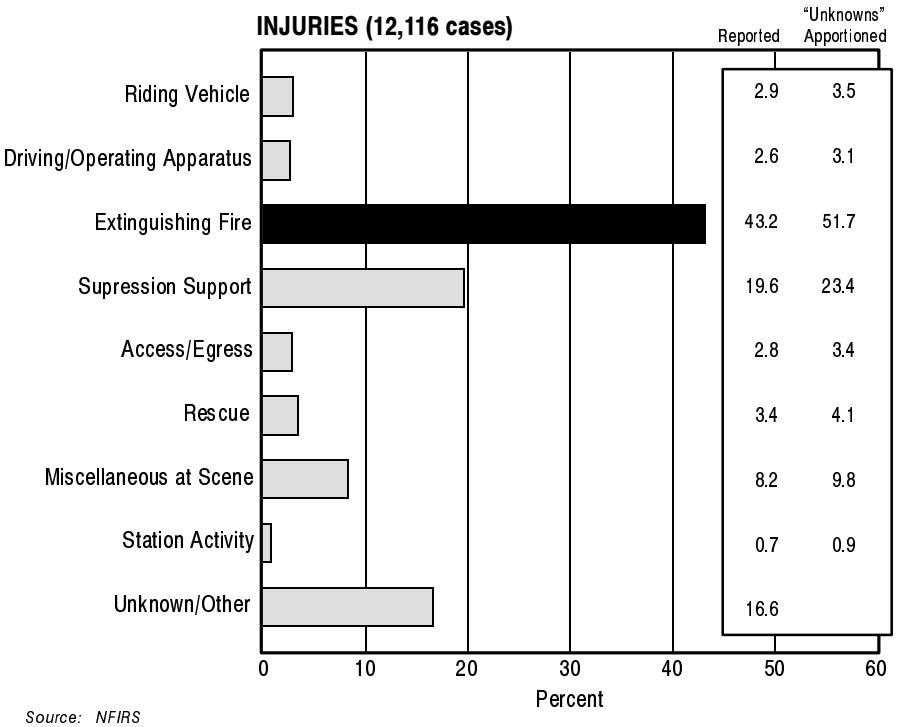
Source: NFIRS

Figure 125. 1994 Firefighter Injuries by Cause



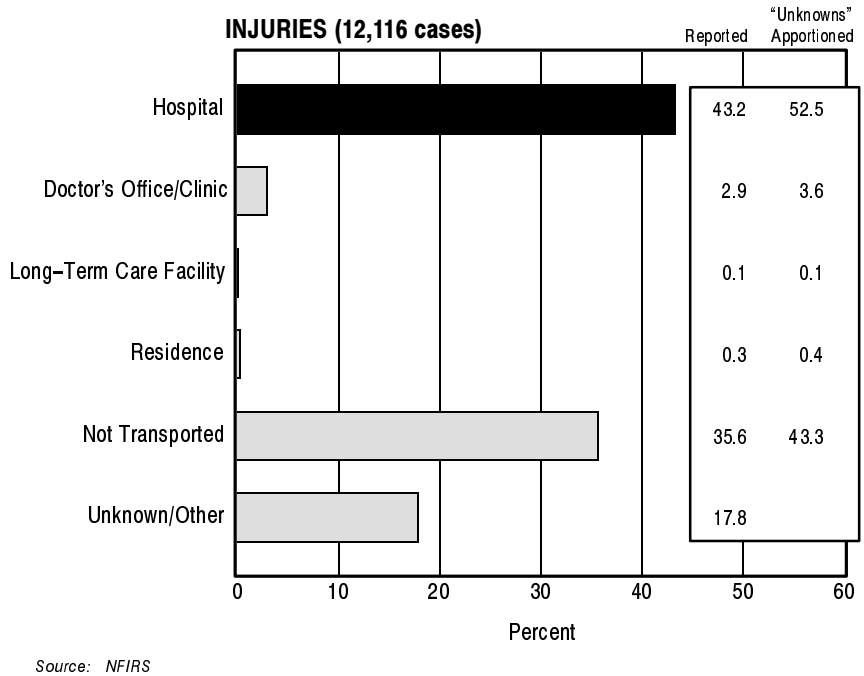
Source: NFIRS

Figure 126. 1994 Firefighter Injuries (All Fires) by Where Injury Occurs



Source: NFIRS

Figure 127. 1994 Firefighter Injuries by Type of Activity



Source: NFIRS

Figure 128. 1994 Firefighter Injuries (Fire Incidents) by Where Treated

USFA RESOURCES ON FIREFIGHTER CASUALTIES

Publications

The U.S. Fire Administration recently revised its NFIRS Firefighter Casualty Report to improve the quality of available data in its annual review of firefighter line-of-duty deaths. This and other USFA-supported research and development are intended to increase the safety and well-being of emergency response personnel. USFA encourages sharing of research findings and incorporation of innovations in equipment available to firefighters and other responders through programs that focus on health and safety studies; research, training and awareness; emergency medical services; search and rescue; and equipment and technology development.

Because accidents involving emergency vehicles are one of the leading causes of firefighter death and injury, USFA has several resources on the subject for fire departments and emergency medical services departments. *Emergency Vehicle Driver Training* (#FA–110) is a 220-page training package that includes both an instructor manual and a student workbook designed to assist fire and emergency medical service (EMS) departments with training in emergency vehicle operations. *Alive on Arrival—Tips of Safe Emergency Vehicle Operations* (#L–195) is a pamphlet detailing actions that emergency vehicle operators, passengers, and officers-in-charge can do to improve safe operation of emergency vehicles.

Also available is a 48-page special report titled *Fire Apparatus/Train Collision* (#FA–104), which presents the investigation of the collision near Catlett, Virginia, on September 28, 1989.

Publications addressing incident response issues have been developed for fire and EMS departments. Among these are *Emergency Incident Rehabilitation* (#FA–114), a short booklet that includes a sample standard operating procedure and guidelines for establishing a rehab area to reduce heat- or cold-related injuries to emergency response personnel operating in labor-intensive or extreme climate conditions.

Guides are also available on recommended safe practices, including response to crashes involving cars equipped with air bags and on a comprehensive safety program designed for fire department safety officers.

USFA also emphasizes research and development of protective clothing for chemical, emergency medical, and search-and-rescue emergencies as well as structural firefighting protective clothing and self-contained breathing apparatus (SCBA). For example, USFA has been involved in the development of a new test method for evaluating the performance of complete firefighter protective clothing ensembles. A suite integrity field test was conducted during hazardous materials training for USFA's study, *Qualitatively Evaluating the Comfort, Fit, Function, and Integrity of Chemical Protective Suite Ensembles* (#FA–107). Three protective clothing ensembles were evaluated in *Physiological Field Evaluation of Hazardous Materials Protective Ensembles* (#FA–109). Another study, the *Non-Destructive Testing and Field Evaluation of Chemical Protective Clothing* (#FA–1060), details a procedure, field tested by the Cambridge, Massachusetts, Fire Department,

developed for assessing the presence of contamination before or after decontamination of chemical protective clothing.

USFA has supported research into health hazards faced by firefighters, including the *Northwest Firefighters Mortality Study: 1945–1989* (#FA–105). USFA also supports symposia on the occupational health and hazards of the fire service focusing on emerging firefighter safety and health issues.

A manual has been prepared for emergency response managers on infection control programs based on federal laws, regulations, and standards. The *Guide to Developing and Managing an Emergency Service Infection Control Program* (#FA–112) addresses modes of disease transmission, measures for prevention, incident response and recovery, station issues, and training/role modeling. The 200-page manual provides a step-by-step approach to designing, implementing, managing, and evaluating a fire or emergency medical services department infection control program. The guide also is a key resource in a National Fire Academy course on infection control.

USFA has developed a series of comprehensive manuals for fire service and EMS managers interested in instituting programs for firefighter health promotion and injury prevention. The 80-page *Fire and Emergency Service Hearing Conservation Program Manual* outlines measures to reduce the risk of occupationally induced hearing loss. USFA also is conducting research to identify causes and to develop solutions to reduce the stress level in EMS providers. A 175-page *Stress Management Model Program* (#FA–100) is available.

USFA has also studied major urban search-and-rescue incidents for lessons learned regarding safety of firefighting, EMS, and other rescue personnel. Six reports published in November 1992 describe *Urban Search and Rescue: in Will County, Illinois, Following the 1990 Tornado* (#FA–122); *in Crested Butte, Colorado State Bank, Following an Explosion Collapse* (#FA–120); *in New York City, Following a Commercial Building Collapse* (#FA–121); *in Brownsville, Texas, Following a Commercial Building Collapse* (#FA–123); *in the Santa Cruz Area, Following the Loma Prieta Earthquake* (#FA–124); and *in San Bernadino, California, Following a Major Train Derailment in a Residential Neighborhood* (#FA–125).

Reports produced under USFA's Major Fires Investigations series are directed primarily to chief fire officers, training officers, fire marshals, and investigators as a resource for training and prevention. Recent reports on incidents with firefighter deaths and injuries include: *Four Firefighters Killed, Trapped by Floor Collapse, Brackenridge, Pennsylvania, December 20, 1991* (#061); *Indianapolis Athletic Club Fire (Two Firefighter Fatalities), Indianapolis, Indiana, February 6, 1991* (#063); *Six Firefighter Fatalities in Construction Site Explosion, Kansas City, Missouri, November 1988* (#024); *Three Firefighter Fatalities in Training Exercise, Milford, Michigan, October 1987* (#015); *High-Rise Office Building Fire, One Meridian Plaza, Philadelphia, Pennsylvania, February 1991* (#049); and *Wood Truss Roof Collapse Claims Two Firefighters, Memphis, Tennessee, January 1993* (#069). The report on *Michigan—Industrial Plastics Fire Sends 97 to Hospital, Flint, Michigan, November 1988* (#025) credits the successful outcome of this fire to the incident command system used, including a strict requirement for SCBA use and rotation of personnel.

These publications are available by writing to:

U.S. Fire Administration
Federal Emergency Management Agency
Publications Center, Room N310
16825 S. Seton Avenue
Emmitsburg, MD 21727

Documents may also be ordered via the World Wide Web: *http://www.usfa.fema.gov.* USFA publications are free.

Video Training

FEMA's Emergency Education NETwork (EENET) provides video training and education via satellite for the fire service and emergency management community. EENET programs are satellite-distributed videoconferences broadcast over the "C" band and allow for audience interaction when originally broadcast. Each program is designed as a standalone training activity of 4½ hours, and student materials are provided for each workshop.

Several previous EENET programs dealing with firefighter health and safety include the following:

- *U.S. Fire Administration's Forum on Communicable Diseases,* May 17, 1989
- *Heat Stress Induced by Chemical Protective Clothing,* July 19, 1989
- *Protective Actions for Hazardous Materials,* October 4, 1989
- *Infection Control: Today's Requirements for Fire and EMS Departments,* December 4, 1991
- *Chemical Protective Clothing Standards: An Overview of NFPA 1991, 1992 & 1993,* June 24, 1992
- *Protective Clothing for Emergency Medical Operations: An Overview of NFPA 1999,* August 19, 1992

Tapes of these and other broadcasts from 1989 to the present are available for a modest cost through:

The National Audiovisual Center
Customer Service Section
8700 Edgeworth Drive
Capitol Heights, MD 20743–3701
(301) 763–1896; (800) 788–6282 for credit card orders

In addition, all broadcasts prior to 1989 and all current broadcasts may be borrowed from state emergency management offices or from FEMA regional offices.

For further information on EENET or if you would like to get on the EENET mailing list, contact:

Emergency Education NETwork
National Emergency Training Center
16825 S. Seton Avenue
Emmitsburg, MD 21727
(301) 447–1068; Fax: (301) 447–1363

National Fire Academy Courses

USFA's National Fire Academy (NFA) works to enhance the ability of the fire service and allied professions to deal more effectively with fire and related emergencies. Courses are delivered on campus at the resident facility in Emmitsburg, Maryland, and off campus throughout the nation in cooperation with state and local fire training officials and local colleges and universities. A new initiative begun in 1992 offers NFA resident courses on a regional basis. Expanded opportunities are available for fire service personnel to participate in academy courses that are handed off through NFA's train-the-trainer program. Academy handoff courses are also available through the National Audiovisual Center.

While firefighter health and safety issues are addressed in numerous NFA courses, several offerings include these issues as a major thrust. NFA's course on *Command and Control of Fire Department Major Operations* (Resident Course #R304) is a 2-week on-campus course for fireground managers that links the subjects of fireground operations and safety. Emphasis is placed on increasing the command officer's awareness regarding the causes of firefighter fatalities and types and kinds of injuries.

Protective clothing and breathing apparatus are among the topics covered in NFA's course on *Hazardous Materials Operating Site Practices* (Resident Course #R229), which focuses on the strategies and safe procedures for alleviating the danger of a hazardous materials accident.

Firefighter safety is also an emphasis in NFA's *Volunteer Incentive Program*, a series of on-campus courses designed specifically for volunteer fire officers.

An off-campus course addressing firefighter health and safety issues is *Firefighter Safety and Survival: The Company Officer's Responsibility (FSCO)*. This course examines significant areas of firefighter fatalities and injuries associated with emergency and non-emergency situations and provides recommended solutions and implementation methods. Another off-campus offering is *Firefighter Health and Safety: Program Implementation and Management (FHSP)*, which focuses on the design and implementation of a departmental safety program. *Infection Control for Emergency Response Personnel: The Supervisor's Role and Responsibilities (ICERP)* is a 2-day course covering a broad range of infection control issues.

For information about course offerings, eligibility, and application procedures, write to:

The National Fire Academy
U.S. Fire Administration
16825 S. Seton Avenue
Emmitsburg, MD 21727

National Fire Academy off-campus course materials are available for purchase for locally sponsored delivery from the National Audiovisual Center. Current academy off-campus courses, consisting of an instructor guide, student manual, and supporting audiovisual aids, are also available. Courses available for purchase include *Firefighter Safety and Survival: The Company Officers Responsibility (1988)*, *Firefighter Health and Safety: Program Implementation and Management (1988)*, and *Infection Control for Emergency Response Personnel: The Supervisors Role and Responsibilities (1993)*. For information on how to order courses, contact the National Audiovisual Center at the address and phone number listed earlier.